method includes the step of receiving a received signal, generating an AGC-output signal, despreading the AGC-output signal, processing the despread AGC-output signal to generate a received-power level, generating a power-command signal, transmitting the power-command signal as a second spread-spectrum signal, despreading the power-command signal from the second spread-spectrum signal as a power-adjust signal, and adjusting a power level of the first spread-spectrum signal.

The received signal includes the first spread-spectrum signal and an interfering signal and is received at the base station. The AGC-output signal is generated at the base station and despread as a despread AGC-output signal. The despread AGC-output signal is processed at the base station to generate a received-power level.

The received-power level is compared to a threshold, with the comparison used to generate a power-command signal. If the received-power level were greater than the threshold, the power-command signal would command the mobile station to reduce transmitter power. If the received-power level were less than the threshold, the power-command signal would command the mobile station to increase transmitter power.

The power-command signal is transmitted from the base station to the mobile station as a second spread-spectrum signal. Responsive to receiving the second spread-spectrum signal, the mobile station despreads the power-command signal as a power-adjust signal. Depending on whether the power-command signal commanded the mobile station to increase or decrease transmitter power, the mobile station, responsive to the power adjust signal, increases or decreases the transmitter-power level of the first spread-spectrum signal, respectively.

The method may additionally include generating from a received signal an AGC-output signal, and despreading the AGC-output signal. The received signal includes the first spread-spectrum signal and an interfering signal. The received signal is processed with the despread AGC-output signal to generate a received-power level. The method then generates a comparison signal by comparing the received-power level to the threshold level. While transmitting a second spread-spectrum signal, the method adjusts a transmitter-power level of the first spread-spectrum signal from the transmitter using the power-adjust signal.

Performance of the Invention

A spread spectrum base station receives all incoming signals simultaneously. Thus, if a signal were received at a higher power level than the others, then that signal's receiver has a nigher signal-to-noise ratio and therefore a lower bit error rate. The base station ensures that each mobile station transmits at the correct power level by telling the remote, every 500 microseconds, whether to increase or to decrease the mobile station's power.

FIG. **7** shows a typical fading signal which is received at the base station along with ten other independently fading signals and thermal noise having the same power as one of the signals. Note that the fade duration is about 5 milliseconds which corresponds to vehicular speed exceeding 60 miles per hour. FIGS. **8**–**9** illustrate the results obtained when using a particular adaptive power control algorithm. In this case, whenever the received signal changes power, the base station informs the remote and the remote varies its power by ±1 dB. FIG. **8** shows the adaptive power control signal at the remote station. FIG. **9** shows the received power at the base station. Note that the adaptive power control track the deep fades and as a result 9 dB fades resulted. This reduces power level resulted in a bit error rate of 1.4×10^{-2}.

For the same fade of FIG. **7**, assume a different adaptive power control algorithm is employed. In this case the control voltage results in the remote unit changing its power by a factor of 1.5 in the same direction, or by a factor of 0.5 in the opposite direction. In this particular implementation the minimum step size was 0.25 dB and the maximum step size was 4 dB. The resulting control voltage is shown in FIG. **10** and the resulting received power from the remote unit is shown in FIG. **11**. Note that the error is usually limited to ±2 dB with occasional decreases in power by 5 dB to 6 dB resulting in a BER $\approx 8\times10^{-4}$, a significant improvement compared to the previous algorithm. The use of interleaving and forward error correcting codes usually can correct any errors resulting from the rarely observed power dips.

It will be apparent to those skilled in the art that various modifications can be made to the method and apparatus adaptively controlling a power level of a spread-spectrum signal in a cellular environment of the instant invention without departing from the scope or spirit of the invention, and it is intended that the present invention cover modifications and variations of the method and apparatus for adaptively controlling a power level of a spread-spectrum signal in a cellular environment provided they come in the scope of the appended claims and their equivalents.

What is claimed is:

1. A communication station for use in a cellular-communications network using spread-spectrum modulation wherein a second station transmits a specific spread-spectrum signal at an adjustable power level, the communication station receives signals including the specific spread-spectrum signal and the communication station includes a transmitter and an associated antenna for transmitting spread-spectrum signals to the second station, the communication station comprising:

automatic gain control means for normalizing a power level associated with the received signals;

means for despreading said normalized received signals with a unique code to produce a despread signal corresponding to the specific spread-spectrum signal;

means for narrow band filtering said despread signal;

power measurement means for multiplying the received signals with said filtered despread signal and measuring a power level associated with a resultant multiplied signal to obtain a received power level associated with said specific spread-spectrum signal; and

means for generating a power command signal by comparing said received power level with a threshold level for controlling a variable-gain device in the second station for adjusting the transmit power level.

2. The communication station according to claim **1** wherein the multiplying is by logarithmically adding the received signals to said filtered despread signal and measuring a power level associated with a resultant logarithmically added signal.

3. The communication station according to claim **1** wherein said power command signal generating means further comprises:

a comparator to compare said received power level with a threshold level; and

a control word generator for generating said power command signal in response to the comparison.

4. The communication station according to claim **1** wherein the communication station is a base station communicating with a plurality of mobile stations and the